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1973

SPECIAL REPORT

USDA--FOREST SERVICE PAKISTAN SPRAY PROJECT

SPRAYING THE RICE CROP OF PAKISTAN

FOR

RICE STEM BORER

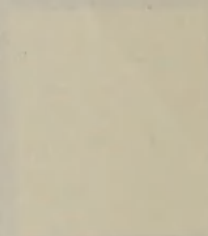
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November 1973

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INTRODUCTION

On August 25, 1973, the Foreign Disaster Relief Coordination Center of the Department of State contacted the USDA Forest Service (FS) for assistance in spraying the Pakistani rice crop. Damaged by the most disastrous floods in recorded history in August, the remaining crop was further threatened by an infestation of rice stem borer (fig. 1), which could seriously affect the country's food supply for the coming year.

Time for accomplishment of this task was very limited. Spraying had to be complete 2 weeks before harvest. By August 31, authorization had been received by the State Department from Pakistan, the Forest Service had agreed to participate and work began.

This is a report of the Forest Service team that was sent to accomplish the spray operation. The team consisted of four personnel from the Missoula Equipment Development Center (MEDC) and a pilot from the Intermountain Region (R-4).

DISCUSSION

The effort of the Forest Service can be conveniently divided into four major areas (refer to appendix 1 for a calendar of significant events).

Assembly and Transport of Personnel and Equipment to Pakistan

Two spray systems, designed and built by MEDC, were available at Missoula, Montana. The systems had been designed to spray low volumes in forested areas from C-47 aircraft. The systems are unique in that an inert gas is used to propel the insecticide from the aircraft rather than engines and pumps. Thus they are simple to install and operate, and have proven to be very reliable. Since C-47 aircraft were available to Pakistan and the spray systems were adaptable to the rice project it was decided on August 31 that a team knowledgeable in spray operations and the spray systems would be sent over as quickly as possible.

Authorization to proceed was received on the Friday preceding the Labor Day weekend. Nozzles for a variety of application rates, nitrogen, ground handling pumps, a generator set, tools and a multitude of other items had to be assembled or purchased. Several commercial companies opened their establishments over the weekend to assist in the job. Cooperation was excellent in all areas and by Tuesday everything was packaged and ready for shipment from Malmstrom Air Force Base (fig. 2). The team then flew to Seattle for passports. All men and equipment were enroute overseas on the night of September 5.

Figure 1.--Rice Stem Borer

The major concern during this period was establishment of requirements to be met for the spray project. Among the many unknowns were: application rate, number of acres to be sprayed, maximum length of spray period and facilities available for installation and maintenance in the field. Communication with and within Pakistan was difficult because of the flood and assumptions had to be made. The team, therefore, prepared for spraying 8 to 64 ounces per acre, up to 400,000 acres through the month of September. It was assumed that maintenance facilities would be nonexistent.

Another unknown which caused some frustrating moments enroute was the palletized loading system used in the C-141 aircraft. It is a very efficient system if the cargo is properly packaged and the prescribed ground loading equipment is available. Although the bulk and weight of the spray equipment were within the capacity of the C-141, pallet configurations caused considerable problems each time the aircraft was loaded and unloaded.

Installation and Checkout

Installation and checkout of the spray systems was accomplished at Lahore, Pakistan between September 9 and September 13, 1973 (figs. 3 and 4). Even though there were some unexpected problems the installation was accomplished within the time estimated. Each aircraft was completed and ready for checkout in less than 2 days.

The major problems were:

1. The wing bolt patterns on Air Force C-47's were different from those on which the system had previously been installed. More than one-half of the boom pads had to be redrilled by hand to fit.
2. The floor on one aircraft was not secured to the basic structure. As a result, the floor peeled back from the front when the spray tank was filled during checkout.
3. The spray tank of the first aircraft completed contained residues from previous spray operations. Even though the system performed during checkout, the first two operational sorties at Lahore failed due to clogged nozzles. The nozzles had to be cleaned without contaminating congested areas.
4. Overall, the interest and cooperation between the many groups in the work area was very good. Often, however, the number of people trying to help and the language barriers caused unnecessary delay in accomplishment of a task. This would have been minimized if the many diverse groups had a longer working relationship than the 4 days it took to accomplish the installation. The Pakistani Army mechanics proved very good once they understood the problem.

Figure 3.--Installation of Spray Systems - Lahore, Pakistan

Figure 4.--Spray Equipment Ready for Installation - Lahore, Pakistan

Spraying

Although one sortie was flown from Lahore, in the Punjab, the majority of the C-47 spraying was accomplished out of Nawabshah in the State of Sind. Originally, the helicopter team was to spray the Sind; but because of the great distance between any possible base of operations and the areas to be sprayed (fig. 5), it was decided that the fixed-wing aircraft could accomplish it more efficiently. The flood had damaged all airports or access to airports that were close to the rice fields. Even with the C-47, ferry time from Nawabshah to the rice fields averaged an hour each way.

The operational personnel flew in the C-47 aircraft from Lahore to Nawabshah on September 14. The ground equipment was airlifted to Karachi by a C-141, then trucked to Nawabshah (fig. 6). It arrived early in the morning of September 15.

The first two sorties, one in each aircraft, started at noon. Both were successful and back by 3:00 p.m. A second sortie for each aircraft was planned for the day. These were not flown because three people were sprayed with insecticide when a crewmember inadvertently opened the wrong valve while reloading the first aircraft. One machine was held for possible evacuation of the three people to a hospital in Karachi and the other had to be cleaned of the spilled insecticide.

On September 17 one aircraft returned from a sortie with a bad magneto and could not be returned to service for lack of parts for the remainder of the project. From September 17 through September 22, 1973, the crew of the inoperative aircraft assisted in flying the one aircraft still in service.

Only two sorties were flown on the 18th because the remaining aircraft had an engine that ran rough during takeoff on the second sortie. Service and checkout took so much time that only two flights could be accomplished before dark. On the last day five sorties were flown to an area that required only 35 minutes ferry time each way.

The average sortie required 2-1/2 hours for completion from engine start to return. Four sorties were scheduled each day. Refueling required 20 minutes and runup and taxi required another 15 minutes. The insecticide was reloaded in 10 minutes during the refueling period with the ground handling equipment shown in figure 7.

The spray systems worked well throughout the spray operation. Only one malfunction occurred. A wire to the control panel broke. Repair did not delay the spray operation.

During the spray operation nearly all flight and ground personnel suffered from diarrhea. The food was Pakistani and very spicy. The water was bad, the temperature high and housing facilities were minimal (fig. 8).

Figure 5.--Map of Pakistan

Figure 5.--Map of Pakistan

Figure 6.--Unloading Ground Support Equipment
Nawabshah, Pakistan

Figure 7.--Insecticide Ground Handling System
Nawabshah, Pakistan

Figure 8.--Operational Headquarters for Spray Team
Nawabshah, Pakistan

In all, 29 sorties were flown from Nawabshah to five different areas in the Sind in eight days. The target of 100,000 acres was met, with 5,600 acres sprayed at 32 ounces per acre and the remainder at 24 ounces per acre (see appendix 2 for the amount of insecticide used and the acres sprayed each day).

The areas to be sprayed and the priority of each area was established by Dr. Ed Millet and the Pakistani Plant Protection Agency.

Rice maturity limited the length of time available for spraying. Spraying had to cease approximately two weeks before harvest. The exact date at which the spraying had to be terminated was unknown at the beginning of the operation but was later established as the 22nd of September. One of the priority areas assigned the C-47 aircraft was scratched on the 18th of September because of the advanced state of rice growth.

Aside from rice maturity, other factors affecting the amount of acreage treated were limitations on flying time of flight crews and maintenance and spares for the aircraft. The Air Force limited flight crews to two sorties each per day and there were only two crews available. There were no facilities, spares, nor qualified mechanics for maintenance of the aircraft at Nawabshah.

Dismantling and Return of Equipment

After the last flight all the spray equipment except the tanks were removed from the aircraft at Nawabshah and packaged for truck transport to Karachi. A mechanic arrived from Thailand and repaired the engine on the inoperative aircraft. Both aircraft and personnel were then flown to Karachi.

In Karachi the tanks were removed and the spray equipment and the nitrogen were palletized for shipment on a C-141. One member of the Forest Service team remained to load the equipment; the rest returned to the States via commercial aircraft.

The same problems reoccurred in loading the C-141. The cargo had to be repalletized twice to get it on the aircraft. In the end the C-47 and helicopter spray equipment were loaded and the nitrogen cylinders were left in Karachi.

The last of the equipment and crew left Pakistan on October 2, 1973.

RESULTS

We sprayed 100,100 acres with the C-47 aircraft in the State of Sind in eight days (see appendix 2). Postspray samples indicated a 75 percent reduction in the infestation due to the spray operation (see appendix 3).

CONCLUSIONS

A successful spray operation was accomplished half-way around the world in one month. The target acreage of 100,000 acres was met. More area could have been sprayed in the time available if aircraft maintenance and a third flight crew had been available.

RECOMMENDATIONS

1. In future operations more than cubage and weight must be considered in the transport of the Forest Service spray systems by military aircraft. The C-47 aircraft spray tanks span two standard pallets and specialized loading equipment (K-loader) must be available for loading and unloading either a C-141 or a C-5.
2. If the C-47 spray system should be updated, the following items should be considered:
 - a. An alternate method should be provided for pressurizing the spray tanks. The number and weight of nitrogen cylinders required for a large, remote spray operation is prohibitive. A possible alternative is the inclusion of an air compressor in the ground handling equipment to pressurize a spare set of bottles while the aircraft is in flight.
 - b. The fill connection for the tanks should be made outside the aircraft so that accidental spillage would occur on the ground.
 - c. The support structure for the aircraft tanks should be redesigned to permit installation by forklift from the rear of a tank. Larger diameter, retractable, castored wheels should be provided.
 - d. A cleanout port should be provided for the aircraft tanks to allow a thorough cleaning after each spray operation.
 - e. C-47 wing bolt patterns apparently vary from one aircraft to another. Spare undrilled boom pads and pattern marking materials should be provided in future operations involving installation on previously unused aircraft.

APPENDIX I
CALENDAR OF SIGNIFICANT EVENTS

8-25-73 First contact by George McCloskey of the Department of State with the USDA Forest Service was made.

8-31-73 The USDA Forest Service received authorization to proceed with assembly and packaging of the spray systems and procurement of peripheral equipment and material.

9-3-73 All equipment and material was sent to Malmstrom Air Force Base for shipment by air to Pakistan.

9-6-73 Team and equipment were enroute to Pakistan.

9-9-73 Installation of spray systems in C-47 aircraft began at Lahore, Pakistan.

9-13-73 Installation and checkout of both C-47 aircraft completed and one spray flight was flown from Lahore to the rice fields in the Punjab.

9-14-73 The entire C-47 operation was moved to Nawabshah in the State of Sind.

9-15-73 Spray flights began in the Sind.

9-22-73 Spray flights terminated in the Sind.

- 9-23-73 The aircraft and equipment were moved to Karachi for return to Thailand and the USA.
- 10-2-73 The last of the personnel and equipment departed Pakistan.

APPENDIX 2

FINAL STATISTICS ON C-47 SPRAYING OPERATIONS IN NAWABSHAH

Total amount of Diazinon delivered to Nawabshah:

Net technical pounds:	189,904
Total gallons	22,880 (55 gal. drums)
Total drums	416 (net wt/drum 456.5 lbs)

Daily spraying operations:

<u>Date</u>	<u>Acres</u>	<u>Pesticide (gallons)</u>
Sept. 15	5,600	1,400
Sept. 16	14,000	2,800
Sept. 17	14,000	2,800
Sept. 18	7,000	1,400
Sept. 19	14,000	2,800
Sept. 20	14,000	2,800
Sept. 21	14,000	2,800
Sept. 22	<u>17,500</u>	<u>3,500</u>
TOTAL	<u>100,100</u>	<u>20,300</u>

Summary:

<u>Beginning Inventory</u>	<u>Used</u>	<u>Balance</u>
189,904 lbs.	168,449 lbs.	21,455 lbs.
22,880 gal.	20,300 gal.	2,580 gal.
416 dr.	369 dr.	47 dr.

C-47 spraying operation terminated on the afternoon of September 22. The target of 100,000 acres was reached despite the fact that one aircraft remained inoperative since September 17.

On the morning of September 23 the TDY maintenance technician from Thailand arrived in Karachi with the requested parts and proceeded directly to Nawabshah.

On the afternoon of September 23, both C-47's along with all personnel were flown to Karachi. All remaining equipment, including used and unused nitrogen bottles, arrived in Karachi by truck from Nawabshah the morning of September 24.

Work is now underway to prepare the planes and equipment for return to their respective home bases. The 47 unused drums of Diazinon remain in Nawabshah in the custody of the Plant Protection Department.

Final disposition of these drums will be worked out between USAID and the PPD.

September 24, 1973

APPENDIX 3

September 28, 1973

Meeting at 9:00 a.m. with Mr. Z. A. Munshi, Deputy Secretary for Technical Agriculture and Mr. Naqvi, Entomologist in charge of Ent. Research at Tando Jam Experiment Farm.

Evaluation and Summary notes of observations by two of Mr. Naqvi's research workers for rice stem borer in rice fields sprayed in Sind province by the two AFC-47 spray equipped planed:

At Dokri:

1. Adult moth mortality, 65-70%
2. No egg masses observed
3. No 1st, 2nd, and 3rd instar larvae observed - also no 4th.
4. 5th instar larva alive.

At Larkana down to Baarah:

The report is more or less the same as Dokri.

At Qambar:

1. No adults observed
2. No immature larva
3. Only 4th and 5th instar larva

At Wagan and Ber:

1. 30% mortality on immature larva
2. 4% mortality on 4th and 5th instar larva

Overall larval population:

1. Before treatment - 500 larva per acre
2. After treatment - 100 larva per acre

(or an average of 75 to 80% reduction in before and after treatment counts).

Adult catches in light traps at Dokri - exact figures not available - only report given as 75% reduction after treatment as compared with before.

NOTE: If counts are made 48 to 72 hours after treatments adult moth knock down may be made by counting dead moths on water surface. Where "no moths observed" are noted, these observations were more than 3 or several days after spraying, and the dead moths may have even disintegrated or sunk in the water - so even this observation is encouraging or significant.

Other general notes:

1. No human illness reported from spraying.
2. No adverse effects reported on domestic animals.
3. No adverse effects reported on wildlife.
4. Some fish kill reported in a pond at Bux Jotai.

(I had instructed local people working with us to expect some fish kill in ponds or lakes with still water or no flow, in spray areas using Diazinon.)

Edward R. Millet
Entomologist
U. S. Spray Team in Sind



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1. Before treatment - 500 fish per tank

2. After treatment - 100 fish per tank

(For an example of 15- to 20% reduction in before and after treatment counts.)

Adult catches in light traps at 0000 - exact figures not available - only

report given as 1% reduction after treatment as compared with before.

NOTE: If counts are made 15 to 20 hours after treatment, adults with young

may be made in counting that make the water surface. When "no count

observed" are noted, these observations were made 3 or several days

after spraying, and the fish may have even disappeared by then in

the water - so even this observation is encouraging or significant.

Other general notes:

1. No human illness reported (very rare)

2. No adverse effects reported on domestic animals.

3. No adverse effects reported on wildlife.

4. Some fish kill reported in a pond at San Juan.

(1 has instructed local people working with us to expect some fish kill in

ponds or lakes with still water or no flow, in spray areas using Dieldrin.)

Edward R. Miller

Entomologist

U. S. Army, Texas A. & M.